torque (a mechanical biasing spring 17). (See 2/02 Office Action, page 9). Toward this end, Applicant has amended claim 1 to clarify that the detent torque recited therein is magnetic detent torque. By this amendment, Applicant respectfully submits that claim 1 is patentable over the cited prior art. It is Applicant's position that the cited references, when considered alone or in combination fail to teach or suggest this feature of the invention. That is, none of the references teach or suggest how magnetic detent torque can be used to hold a rotor of an actuator configured for repetitive rotational movement in either of its two angular rotation endpoints during coil deenergization.

I. The Actuator of the Present Invention

Figures 3, 4, and 5 of the application show torque characteristics of the actuator of the present invention. In the figures, the rated torque is the torque generated when the coil is energized at a rated current. The magnetic detent torque is the torque generated when the coil is in a deenergization mode. The angle θ is the relative angular difference between the rotor and the stator. Figures 2(a) and 2(b) illustrate the basic rotational characteristics of the rotor in response to coil energization in the direction of I_1 (clockwise rotation) and I_2 (counter-clockwise rotation).

As can be seen in Figure 4 and the accompanying description in the specification (see Application, page 14, line 7 - page 15, line 15), the rotor will carry out repetitive rotational movement within the angular range of θ_2 to θ_1 (θ_2 to θ_1 being the endpoints of rotational movement) If the rotor lies between θ_3 and θ_1, and the coil is in a deenergization mode (meaning there is no rated torque and that the resultant torque is in effect the detent torque), the rotor will be rotated in the clockwise direction by virtue of the positive magnetic detent torque until the rotor reaches the position of θ_1 where rotation is stopped by a stopper.

While held in position at θ_1, if current is passed in an I_2 direction, then the rotor overcomes the positive magnetic detent torque as the magnitude of the negative rated torque at position θ_1 is greater than the magnitude of the positive magnetic detent torque at position θ_1, thereby making the resultant torque negative and driving the rotor in the counterclockwise direction. If the duration of energization in the I_2 direction is sufficiently long, the rotor will eventually stop at the position of θ_2.

If the duration of energization in the I_2 direction is short, and current is cut off before the rotor reaches θ_3, then the rotor is moved back to the initial position θ_1 by a positive magnetic detent torque. If the duration of energization in the I_2 direction is long enough to move the rotor past position θ_3 toward θ_2, and then the coil is deenergized by cutting off the current, then the rotor will be driven and held at position θ_2 by virtue of the negative magnetic detent torque that exists between position θ_2 and θ_3.

While held at position θ_2, if the current is switched to the I_1 direction, the rotor will begin moving clockwise toward θ_1 by virtue of the resultant torque being positive. As explained above, if the I_1 direction current is cut off before the rotor reaches position θ_3, then the rotor will be driven back and held at the θ_2 position by virtue of the negative magnetic detent torque. If the I_1 direction current is cut off after the rotor passes the θ_3 position but before the rotor reaches position θ_1, then the rotor will be driven forward and held at the θ_1 position by virtue of the positive magnetic detent torque.

"Thus according to the present invention, each time the energizing direction of the coil is switched, the rotor carries out repetitive motion in the range defined by θ_2 and θ_1, and the rotor can be set in a given direction *by making use of detent torque even when the coil is in deenergization mode*." (See Application, page 15, lines 16-21 (emphasis added)). Because the actuator of the present invention can maintain its rotor position even when the coil is deenergized, "the present invention can be applied to, for example, a camera shutter or the like to always hold the shutter closed by the detent torque, open the shutter only for a required period of time by energizing a coil only when taking a photograph (for exposure), then close the shutter by inverse energization. Thereafter, the energization can be cut off to maintain the shutter in the closed state by the detent torque." (See Application, page 15, line 25 - page 16, line 6). This feature is extremely effective to achieve power saving because current is not required to keep the shutter closed.

II. Tojo fails to teach or suggest the use of magnetic detent torque to maintain the rotor's position when the coil is deenergized because Tojo teaches the elimination of magnetic detent torque.

The Office Action cites the Tojo reference as supplying the teaching that detent torque be used during coil deenergization to hold the rotor in a rotational position. However, Tojo teaches quite the opposite. Tojo states that the magnetic detent torque that exists when the

driving coil is turned off is an undesirable feature that causes a need for a large spring force to hold a rotor closed. This large spring force necessitates a large electromagnetic force to drive the throttle valve against the spring force during coil energization, thereby requiring an unnecessarily large-sized torque motor to produce such electromagnetic force. (See Tojo, column 1, lines 23-45).

To improve such motors, Tojo teaches that the stator core be designed to have "a smooth inner periphery with no slot, so that unevenness in the distribution of the magnetic flux density in the stator core can be reduced." (See Tojo, column 1, line 64 - column 2, line 1). Tojo states that as a result of this stator core design, "the detent torque applied to the rotor when the rotor is rotated without current supplied to the solenoid **can be eliminated**." (See Tojo, column 2, lines 1-3). This elimination of magnetic detent torque allows for a reduction in the amount of electromagnetic force needed to drive the throttle valve control device, which thereby allows the device to made smaller and use less power. (See Tojo, column 2, lines 3-8).

Thus, Tojo teaches the elimination of the very property that Applicant utilizes in controlling rotational movement. As such, Applicant respectfully submits that the obviousness rejection based on the combination of Tojo with Komatsu and Atsumi is improper because a person of ordinary skill in the art, upon reading Tojo, would be directed to design an actuator exhibiting no magnetic detent torque rather than an actuator that utilizes magnetic detent torque to hold the rotor in a rotational position when the coil is deenergized.

Rather than using magnetic detent torque to hold the rotor in a rotational position during coil deenergization, Tojo teaches that a mechanical return spring should be used to bias the rotor to a rotational position during coil deenergization. (See Tojo, Figure 2, reference numeral 17; column 4, lines 39-47). To achieve rotor movement during coil energization, the driving current must be of sufficient magnitude to generate enough torque to overcome the biasing force of the spring. (See Tojo, column 4, line 66 - column 5, line 2).

Thus, the Tojo reference teaches one of ordinary skill in the art how to eliminate magnetic detent torque from a motor and how to use a mechanical spring to bias the rotor position during coil deenergization. As such, Tojo fails to provide any teaching that would render claim 1 obvious, and in fact, teaches away from Applicant's invention.

"[A]ll relevant teachings of the cited references must be considered in determining what they fairly teach to one having ordinary skill in the art. [citations omitted] The relevant

portions of a reference include not only those teachings which would suggest particular aspects of an invention to one having ordinary skill in the art, but also teachings which would lead such a person away from the claimed invention." In re Mercier, 185 USPQ 774, 778 (CCPA 1975). Proceeding contrary to the accepted wisdom of the prior art is strong evidence of nonobviousness. W.L. Gore & Associates, Inc. v. Garlock, Inc., 220 USPQ 303, 312 (Fed. Cir. 1983).

In this case, Applicant has proceeded to the contrary of the teachings of Tojo to develop an actuator which uses magnetic detent torque to hold the rotor in a rotational position when the coil is deenergized. If Applicant had relied on the teachings of Tojo in developing the present invention, the actuator would have been designed such that the magnetic detent torque is eliminated and a spring is used to hold the rotor in a rotational position when the coil is deenergized. Instead, Applicant has used the motor's magnetic detent torque to his advantage by relying on the magnetic detent torque to hold the rotor in a rotational position during deenergization, thereby eliminating the need for the spring used by Tojo. This innovation in actuator design is not found, taught, or suggested in the cited references. Therefore, Applicant respectfully submits that claim 1 and all depending claims are allowable.

III. The Komatsu patent fails to teach or suggest the use of magnetic detent torque to hold the rotor in either of two endpoints of repetitive rotational movement during coil deenergization because Komatsu, which addresses a rotary machine not configured for repetitive rotational movement, merely addresses how the detent torque can be adjusted to avoid rotational dead points and rotational irregularities --two issues not involved in the design of actuators configured for repetitive rotational movement.

Komatsu is directed toward the design of a rotary machine such that rotational deadpoints are avoided and that rotational irregularities are reduced. To achieve such a rotary machine, Komatsu discloses that the size of the magnet pole pieces (see reference numerals 22 and 23 is Fig. 1) should be appropriately designed. (See Komatsu, column 3, lines 25-59; column 6, lines 4-26). In discussing the operation of its rotary machine, Komatsu in Figure 3 depicts the starting torque (T10 thru T12) relative to the deenergization torque (Ts). It is important to note that the positions R1 and R2 in Figure 3 are not the endpoints of a range of repetitive rotation movement, but rather zero torque points when the coil is deenergized. The rotor is not designed to rotate back and forth between those two points. (See Komatsu, column 7, lines 11-20).

Also, referring to Figures 6 and 8, angular ranges D21 and D31 are not ranges of repetitive rotational movement, but rather angular ranges within which deadpoints may occur absent appropriate loads and starting voltage. (See Komatsu, column 7, lines 41-54).

Thus, having failed to disclose the use of magnetic detent torque in connection with holding the rotor in either of two endpoints of repetitive rotational movement during coil deenergization, Komatsu fails to render the present invention obvious.

IV. Atsumi fails to teach or suggest the above-discussed feature of the invention because Atsumi fails to contemplate coil deenergization when discussing the rotor's movement within a set angular range.

Atsumi, unlike Komatsu, does address an actuator configured to repetitively rotate within a set angular range. However, the Atsumi reference never discusses the rotor's operation during coil deenergization, let alone magnetic detent torque. As such, Atsumi fails to render the present invention obvious, when considered alone or in combination with the other references.

The operation of Atsumi's rotary actuator is described in column 4 from lines 23 through 51. When the rotor is at either of two rotational endpoints defined by first and second stoppers, the coil's energization is maintained to hold the rotor in the stopped position. (See Atsumi, column 4, lines 24-43). To achieve rotational movement back toward the other endpoint of the rotational range, the coil is energized in the opposite direction. Atsumi fails to teach or suggest coil deenergization once the rotor has reached either of its two stop positions. (See Atsumi, column 4, lines 44-51). Thus, Atsumi fails to teach or suggest the use of magnetic detent torque to hold the rotor in either of its endpoints during coil deenergization.

V. Conclusion

For the foregoing reasons, Applicant respectfully submits that the obviousness rejection of claim 1 is improper. The cited references fail to teach or suggest an important feature of Applicant's invention - the use of magnetic detent torque to hold the rotor in either of the two endpoints of its range of repetitive rotational movement when the coil is deenergized. Tojo, which is cited for disclosing this limitation, in fact teaches that <u>magnetic</u> detent torque should be eliminated and that a <u>mechanical</u> biasing spring should be used to hold the rotor in a rotational position during coil deenergization. Komatsu fails to address how an actuator

designed for repetitive rotational movement can use magnetic detent torque during coil deenergization as claimed by Applicant because Komatsu is addressed to a rotary machine not configured for repetitive rotational movement, and the detent torque found in Komatsu is not used for holding the rotor at an endpoint of the rotor's rotational range because the Komatsu device is designed such that no endpoints exist -- smooth 360° rotation is the goal of Komatsu. Further, Atsumi utterly fails to address magnetic detent torque and how its rotor will operate during coil deenergization. Accordingly, the Komatsu/Atsumi/Tojo combination fails to render claim 1 obvious. Favorable action is respectfully requested.Respectfully submitted,

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